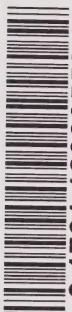


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# NEUTRALIZATION OF CREAM FOR BUTTERMAKING



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By W. F. JONES, B.S.A.

CHIEF, DIVISION OF DAIRY MANUFACTURES

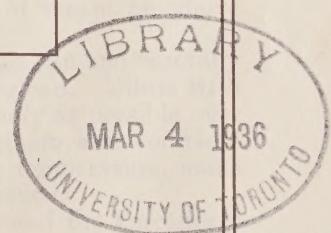
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The Dairy and Cold Storage Branch

J. A. RUDDICK, Commissioner

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# NEUTRALIZATION OF CREAM FOR BUTTERMAKING

By W. F. JONES,

*Chief, Division of Dairy Manufactures*

The partial neutralization of the lactic acid in cream is necessary to ensure the efficient pasteurization of cream for buttermaking. The pasteurization of unneutralized cream results in a high loss of fat in the buttermilk and a poorer quality of butter owing to a higher curd content. When butter is made from unpasteurized cream, neutralization is unnecessary and inadvisable.

The efficient neutralization of cream requires an intelligent observance of details—the testing of cream for acidity, preparation of neutralizing solution, method of applying the neutralizer, the determination of the required amount of neutralizer and the temperature of cream when adding the neutralizer. If any one of these details be neglected, the optimum results from neutralization cannot be expected.

*Testing Cream for Acidity.*—Thoroughly mix the cream in pasteurizer by the revolving coil, at the same time raising the temperature to 70° F. Turn off the steam, but let the coil continue to revolve. Obtain a representative sample of cream from the vat and determine the percentage of acidity as described on page 5.

## PREPARATION AND APPLICATION OF NEUTRALIZERS

### (1) LIME

*Preparation.*—Boil 48 pounds of water in an 8-gallon can. Add 8 pounds of quick lime (CaO) in small lots to the boiling water and stir. After the lime is well slaked, strain the mix through several thicknesses of cheesecloth into a 30-gallon can. Add 24 pounds of hot water and thoroughly mix.

When the lime mix is made up in the above proportion—1 pound of lime to 9 pounds of water—the amount of solution required to neutralize a definite amount of cream to an acidity of .25 per cent can easily be determined by consulting Table No. 1, page 6.

*Application.—Note.* The pasteurizer coil was left running while the acidity test was being made. The temperature of cream after making the acidity test and weighing the required amount of neutralizer will be between 76° F., and 80° F. Under no circumstances should the temperature of cream be above 100° F., before neutralizing.

Thoroughly mix the lime solution in the 30-gallon storage can and carefully weigh the required amount into a common garden sprinkling can. Dilute with an equal amount of water, mix thoroughly and spray as evenly as possible over the surface of the cream, the coil in motion. Turn on steam and complete pasteurization in the usual way. When cooled to churning temperature, make final acidity test of cream to check the accuracy of your methods.

Owing to the fact that lime varies in purity, strength and the percentage of lime which fails to react with lactic acid, buttermakers who depend on neutralizing tables for determining the amount of neutralizer to use, must give the subject their intelligent attention. However, it is a simple matter to determine the necessary correction should the lime be a little stronger or weaker than that indicated by the table, e.g.: Supposing cream with an initial acidity of .55 per cent shows an acidity of .23 per cent after neutralization, i.e., .02 lower than it should have been according to the table. When calculating the required amount of neutralizer to use for the next churning, deduct .02 from the initial acidity. Assuming that the initial acidity be .53 per cent, the amount of neutralizer required will be found in the column under .51 (.53 — .02). Should the final acidity be higher than indicated by the table, e.g., .28 per cent, add the difference, in this case, .03 (.28 — .25) to the initial acidity of the cream before

consulting the table. The final acidity test should *not* be made until the cooling process has been completed and preferably just before churning.

All the neutralizing tables observed by the writer are based on a final acidity of .25 per cent. Some buttermakers are afraid of a neutralized flavour in the resulting butter when reducing cream from a high acidity, .7 per cent—.8 per cent, to .25 per cent and prefer a final acidity of .3 per cent. By deducting the difference between the final acidity of the table and that desired by the buttermaker, in this case .05 (.30 — .25) from the initial acidity of the cream, the table can still be used for determining the amount of neutralizer required.

## (2) WYANDOTTE

*Preparation.*—Wyandotte is readily soluble in water so that the solution can be prepared immediately before application to cream.

*Application.*—Determine the pounds of acid in the cream to be neutralized by the following method. Subtract the desired final acidity from the initial acidity, multiply the number of pounds of cream by this figure and divide by 100, e.g.:

$$\begin{array}{rcl}
 \text{Pounds of cream} & = & 2300 \\
 \text{Initial acidity} & = & \underline{.65\%} \\
 \text{Final acidity} & = & \underline{.25\%} \\
 & & \underline{.40\%} \\
 \hline
 2300 \times .40 & & \\
 \hline
 100 & = & 9.2 \text{ pounds of acid to be neutralized.}
 \end{array}$$

Since 1 pound of Wyandotte neutralizes 1 pound of acid, 9.2 pounds of Wyandotte are required in the above example to reduce the acidity of the cream to .25 per cent.

Thoroughly dissolve the required amount of Wyandotte in hot water—8 pounds of water to 1 pound of Wyandotte—pour into a common garden sprinkling can and proceed as outlined under "Lime".

*Note.*—The strength of Wyandotte varies. The results of experimental work by Mr. Geo. H. Barr, Dairy Division, Department of Agriculture, Ottawa, demonstrated that 1 pound of Wyandotte neutralized 1 pound of acid. In subsequent experiments, 1 pound of Wyandotte neutralized nearly 1.25 pounds acid (1.2454). The strength of different lots of Wyandotte must therefore be determined individually, e.g.:

$$\begin{array}{rcl}
 \text{Pounds of cream} & = & 2000 \\
 \text{Initial acidity} & = & \underline{.60\%} \\
 \text{Desired final acidity} & = & \underline{.25\%} \\
 & & \underline{.35\%} \\
 \hline
 2000 \times .35 & & \\
 \hline
 100 & = & 7.00 \text{ pounds of acid to be neutralized.}
 \end{array}$$

7.00 pounds of Wyandotte applied to cream.

Actual final acidity = .20%

Therefore, .60 — .20 = .40% acid neutralized.

$$\begin{array}{rcl}
 2000 \times .40 & & \\
 \hline
 100 & = & 8.0 \text{ pounds of acid actually neutralized.}
 \end{array}$$

Therefore 7.0 pounds of Wyandotte neutralized 8.0 lbs. acid.

$$\begin{array}{rcl}
 1 \text{ pound of Wyandotte neutralized} & 8.0 & = 1 1-7 \text{ pounds} \\
 & & \hline
 & & \text{acid.} \\
 & & 7.0
 \end{array}$$

## (3) SODIUM BICARBONATE. (BAKING SODA)

*Preparation.*—Same as for Wyandotte.

*Application.*—Determine the amount of sodium bicarbonate required from Table No. 2, page 7 and weigh into suitable container. Add 8 pounds of water for every pound of bicarbonate, thoroughly dissolve, pour into sprinkling can and proceed as outlined in directions for "Lime".

*Note.*—When sodium bicarbonate is used, the cream vats should not be filled, as the cream may foam over the sides of the vat.

For the convenience of buttermakers who do not have a neutralizing table, or who prefer to calculate the amount of sodium bicarbonate to use as outlined under "Wyandotte," the neutralizing effect of sodium bicarbonate as published from the Dairy Commissioner's Office, Edmonton, Alberta, is as follows:—

14.8 ounces of sodium bicarbonate neutralize 1 pound of acid.

## (4) HYDRATED LIME

*Preparation.*—Weigh 75 pounds water in 8-gallon can and mark distinctly the height of water on outside of can. Empty can.

If the hydrated lime is a calcium lime (containing not over 5 per cent magnesium oxide), add 21.5 pounds lime to can, fill half full of cold water, stir until the emulsion is complete, add water up to the 75-pound mark and stir again.

If the hydrated lime is a magnesium lime (containing not less than 30 to 35 per cent magnesium oxide), add 18 pounds of lime and complete mix as above.

*Application.*—Determine amount of neutralizer mix to use from Table No. 3, page 8 (p. 158 "The Butter Industry" by Hunziker) and proceed as outlined under "Lime".

*Note.*—To determine whether the hydrated lime is a calcium or magnesium lime,

- (1) have a sample analysed by a chemist, or
- (2) determine the neutralizing strength as outlined under "Wyandotte".

## TESTING CREAM FOR ACIDITY

Obtain representative sample of cream from vat and weigh 10 grammes into a suitable container. Add 3 drops of phenolphthalein indicator (.5 per cent alcoholic solution). Add normal ninth solution of sodium hydroxide (NaOH) from a graduated burette until a permanent faint pink colour is obtained. Stir with a glass rod while adding the solution. The number of cubic centimeters of sodium hydroxide solution used, divided by ten (10) equals the percentage of acidity in the cream, e.g.:

5.5 c.c. of sodium hydroxide solution required to obtain pink colour,

5.5

Therefore acidity of cream  $\frac{5.5}{10} = .55\%$

Some creamery operators measure 10 c.c. of cream with a pipette for the acidity test. More accurate results are obtained by weighing a ten-gramme sample on the butter moisture scales.

## NEUTRALIZING TABLES

*Neutralizing Table No. 1.*

Strength of Mix.—1 pound of quick lime (CaO) to 9 pounds of water.

*Neutralizing Table No. 2.*

Example.—To reduce the acidity of 1,950 pounds of cream from .57% to .25%.

The table shows the following quantity of sodium bicarbonate is required to reduce the acidity of:

1,000 lb. of cream from	·57%	to	·25%	2 lbs.	15·5 oz.
900	"	"	·57%	to	·25%
50	"	"	·57%	to	·25%
					2·5 oz.
1,950 lbs.				5 lbs.	13·0 oz.

*Neutralizing Table No. 3.*

Strength of Mix—

(1) Calcium lime.

2·4 pounds of dry hydrated lime in 1 wine gallon of lime mix.

(2) Magnesium lime.

2 pounds of dry hydrated lime in 1 wine gallon of lime mix.

The above tables in suitable size for hanging in the creamery may be obtained from the Dairy and Cold Storage Branch, Department of Agriculture, Ottawa.

NEUTRALIZING TABLE No. 1

POUNDS OF LIME MIX (QUICK LIME) REQUIRED TO REDUCE ACIDITY TO ·25 PER CENT

Pounds of Cream	Per Cent Acid in Cream														
	·80%	·79%	·77%	·75%	·73%	·71%	·69%	·67%	·65%	·63%	·61%	·59%	·57%	·55%	·53%
lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.
1000.....	19·0	18·5	17·5	17·0	16·5	16·0	15·0	14·5	13·5	13·0	12·5	11·5	11·0	10·5	9·5
1100.....	20·5	20·0	19·5	19·0	18·0	17·5	16·5	16·0	15·0	14·5	13·5	13·0	12·0	11·5	10·5
1200.....	22·5	22·0	21·5	20·5	20·0	19·0	18·0	17·5	16·5	15·5	15·0	14·0	13·0	12·5	11·5
1300.....	24·5	24·0	23·0	22·5	21·5	20·5	19·5	18·5	18·0	17·0	16·0	15·0	14·0	13·5	12·5
1400.....	26·0	26·0	25·0	24·0	23·0	22·0	21·0	20·0	19·0	18·0	17·0	16·5	15·5	14·5	13·5
1500.....	28·0	27·5	26·5	25·5	24·5	23·5	22·5	21·5	20·5	19·5	18·5	17·5	16·5	15·5	14·5
1600.....	30·0	29·5	28·5	27·5	26·5	25·5	24·0	23·0	22·0	21·0	20·0	18·5	17·5	16·5	15·5
1700.....	32·0	31·5	30·0	29·0	28·0	27·0	25·5	24·5	23·5	22·0	21·0	20·0	18·5	17·5	16·5
1800.....	34·0	33·5	32·0	31·0	29·5	28·5	27·0	26·0	24·5	23·5	22·0	21·0	19·5	18·5	17·5
1900.....	36·0	35·0	34·0	32·5	31·5	30·0	28·5	27·5	26·0	25·0	23·5	22·0	20·5	19·5	18·0
2000.....	38·0	37·0	35·5	34·5	33·0	31·5	30·0	29·0	27·5	26·0	24·5	23·5	22·0	20·5	19·0
2100.....	39·5	39·0	37·5	36·0	34·5	33·0	31·5	30·0	29·0	27·5	26·0	24·5	23·0	21·5	20·0
2200.....	41·5	41·0	39·0	38·0	36·5	34·5	33·0	31·5	30·0	28·5	27·0	25·5	24·0	22·5	21·0
2300.....	43·5	42·5	41·0	39·5	38·0	36·5	34·5	33·0	31·5	30·0	28·5	27·0	25·0	23·5	22·0
2400.....	45·0	44·5	42·5	41·0	39·5	38·0	36·0	34·5	33·0	31·0	29·5	28·0	26·5	24·5	23·0
2500.....	47·0	46·0	44·5	43·0	41·0	39·5	37·5	35·0	34·0	32·5	31·0	29·0	27·5	25·5	24·0
2600.....	49·0	48·0	46·0	44·5	43·0	41·0	39·0	36·5	35·5	34·0	32·0	30·5	28·5	26·5	25·0
2700.....	51·0	50·0	48·0	46·5	44·5	42·5	40·5	38·0	37·0	35·0	33·0	31·5	29·5	28·0	26·0
2800.....	53·0	52·0	50·0	48·0	46·0	44·0	42·0	39·5	38·5	36·5	34·5	32·5	30·5	29·0	27·0
2900.....	54·5	53·5	51·5	50·0	48·0	46·0	43·5	41·0	40·0	37·5	35·5	34·0	32·0	30·5	28·0
3000.....	56·5	55·5	53·0	51·5	49·5	47·5	45·0	42·5	41·0	39·0	37·0	35·0	33·0	31·5	29·0

NEUTRALIZING TABLE No. 1  
POUNDS OF LIME MIX (QUICK LIME) REQUIRED TO REDUCE ACIDITY TO ·25 PER CENT

Pounds of Cream	Per Cent Acid in Cream														
	·51%	·49%	·47%	·45%	·43%	·41%	·40%	·39%	·37%	·35%	·33%	·31%	·30%	·29%	·27%
lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.
1000.....	9·0	8·0	7·5	7·0	6·0	5·5	5·0	5·0	4·0	3·5	2·5	2·0	1·5	1·5	·5
1100.....	10·0	9·0	8·5	7·5	6·5	6·0	5·5	5·5	4·5	4·0	3·0	2·0	2·0	1·5	·5
1200.....	10·5	10·0	9·0	8·0	7·5	6·5	6·0	6·0	5·0	4·0	3·5	2·5	2·0	1·5	1·0
1300.....	11·5	10·5	10·0	9·0	8·0	7·0	6·5	6·0	5·5	4·5	3·5	2·5	2·0	1·5	1·0
1400.....	12·5	11·5	10·5	9·5	8·5	7·5	7·0	6·5	6·0	5·0	4·0	3·0	2·5	2·0	1·0
1500.....	13·5	12·5	11·5	10·5	9·0	8·0	7·5	7·0	6·0	5·0	4·0	3·0	2·5	2·0	1·0
1600.....	14·5	13·0	12·0	11·0	10·0	9·0	8·0	7·5	6·5	5·5	4·5	3·5	3·0	2·0	1·0
1700.....	15·0	14·0	13·0	11·5	10·5	9·5	8·5	8·0	7·0	6·0	4·5	3·5	3·0	2·5	1·0
1800.....	16·0	15·0	13·5	12·5	11·0	10·0	9·5	8·5	7·5	6·0	5·0	3·5	3·0	2·5	1·0
1900.....	17·0	15·5	14·5	13·0	11·5	10·5	10·0	9·0	8·0	6·5	5·0	4·0	3·5	2·5	1·5
2000.....	18·0	16·5	15·0	14·0	12·5	11·0	10·5	9·5	8·0	7·0	5·5	4·0	3·5	3·0	1·5
2100.....	19·0	17·5	16·0	14·5	13·0	11·5	11·0	10·0	8·5	7·0	5·5	4·5	4·0	3·0	1·5
2200.....	19·5	18·0	16·5	15·0	13·5	12·0	11·5	10·5	9·0	7·5	6·0	4·5	4·0	3·0	1·5
2300.....	20·5	19·0	17·5	16·0	14·0	12·5	12·0	11·0	9·5	8·0	6·5	5·0	4·0	3·0	1·5
2400.....	21·5	19·5	18·0	16·5	15·0	13·0	12·5	11·5	10·0	8·0	6·5	5·0	4·5	3·5	1·5
2500.....	22·5	20·5	19·0	17·0	15·5	13·5	13·0	12·0	10·5	8·5	7·0	5·0	4·5	3·5	1·5
2600.....	23·0	21·5	19·5	18·0	16·0	14·0	13·5	12·5	10·5	9·0	7·0	5·5	4·5	3·5	2·0
2700.....	24·0	22·0	20·5	18·5	16·5	15·0	14·0	13·0	11·0	9·0	7·5	5·5	5·0	3·5	2·0
2800.....	25·0	23·0	21·0	19·5	17·0	15·5	14·5	13·5	11·5	9·5	7·5	6·0	5·0	4·0	2·0
2900.....	26·0	24·0	22·0	20·0	17·5	16·0	15·0	14·0	12·0	10·0	8·0	6·0	5·0	4·0	2·0
3000.....	27·0	24·5	22·5	20·5	18·0	16·5	15·5	14·5	12·5	10·0	8·0	6·0	5·0	4·0	2·0

## NEUTRALIZING TABLE No. 2

WEIGHT OF SODIUM BICARBONATE TO REDUCE ACIDITY TO .25 PER CENT

Pounds of Cream	Per Cent Acid in Cream											
	.60%	.59%	.58%	.57%	.56%	.55%	.54%	.53%	.52%	.51%	.50%	
lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	
50.....	2.5	2.5	2.5	2.5	2.5	2.0	2.0	2.0	2.0	2.0	2.0	
100.....	5.0	5.0	5.0	5.0	4.5	4.5	4.5	4.0	4.0	4.0	3.5	
200.....	10.5	10.0	10.0	9.5	9.0	9.0	8.5	8.5	8.0	7.5	7.5	
300.....	15.5	15.0	14.5	14.5	14.0	13.5	13.0	12.5	12.0	11.5	11.0	
400.....	15.0	14.0	13.5	13.0	12.5	12.0	11.5	11.0	10.5	10.5	10.0	
500.....	10.0	9.0	8.5	8.0	7.5	7.0	6.5	6.0	5.5	5.0	4.5	
600.....	15.5	14.5	13.5	12.5	11.5	11.0	10.0	9.0	8.0	7.0	6.5	
700.....	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	
800.....	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	
900.....	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	
1000.....	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
2000.....	6.0	8.0	6.0	5.0	2.0	15.0	12.0	9.0	6.0	3.0	0	

## NEUTRALIZING TABLE No. 2

WEIGHT OF SODIUM BICARBONATE TO REDUCE ACIDITY TO .25 PER CENT

Pounds of Cream	Per Cent Acid in Cream											
	.49%	.48%	.47%	.46%	.45%	.44%	.43%	.42%	.41%	.40%	.39%	.38%
lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.
50.....	2.0	2.0	1.5	1.5	1.5	1.5	1.5	1.0	1.0	1.0	1.0	1.0
100.....	3.5	3.5	3.5	3.0	3.0	3.0	2.5	2.5	2.5	2.0	2.0	2.0
200.....	7.0	7.0	6.5	6.0	6.0	5.5	5.5	5.0	5.0	4.5	4.0	3.5
300.....	10.5	10.5	10.0	9.5	9.0	8.5	8.0	7.5	7.0	6.5	6.0	5.5
400.....	14.5	13.5	13.0	12.5	12.0	11.5	10.5	10.0	9.5	9.0	8.5	7.5
500.....	12.0	11.0	10.0	10.5	15.5	15.0	14.0	13.5	12.5	12.0	11.0	10.5
600.....	1.5	5.5	1.4	4.5	3.5	2.5	2.0	1.0	0	15.0	14.5	13.5
700.....	1.9	0	1.8	0	1.7	0	1.6	0	1.5	1.5	14.5	13.5
800.....	1.12.5	1.11.5	1.10.0	1.9.0	1.8.0	1.6.5	1.5.5	1.4.0	1.3.0	1.2.0	1.1.5	1.0.5
900.....	2.0	0	1.15.0	1.13.5	1.12.0	1.11.0	1.9.5	1.8.0	1.7.0	1.5.5	1.4.0	1.2.5
1000.....	2.3	5	2.15.0	2.12.0	1.15.0	1.14.0	1.12.0	1.10.5	1.9.5	1.8.0	1.6.5	1.5.0
2000.....	4.7.5	4.4.5	4.1.5	3.14.5	3.11.5	3.8.5	3.5.5	3.2.5	3.0	2.12.5	2.9.5	2.6.5

## NEUTRALIZING TABLE No. 2

WEIGHT OF SODIUM BICARBONATE TO REDUCE ACIDITY TO .25 PER CENT

Pounds of Cream	Per Cent Acid in Cream											
	.36%	.35%	.34%	.33%	.32%	.31%	.30%	.29%	.28%	.27%	.26%	
lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	
50.....	1.0	5	5	5	5	5	5	5	2	2	1	
100.....	1.5	1.5	1.5	1.0	1.0	1.0	1.0	1.0	5	5	1	
200.....	3.5	3.0	2.5	2.5	2.0	2.0	2.0	1.5	1.0	1.0	5	
300.....	5.0	4.5	4.0	3.5	3.0	2.5	2.0	2.0	1.5	1.0	5	
400.....	6.5	6.0	5.5	5.0	4.0	3.5	3.0	2.5	2.0	1.0	5	
500.....	8.0	7.5	6.5	6.0	5.0	4.5	3.5	3.0	2.0	1.5	5	
600.....	10.0	9.0	8.0	7.0	6.0	5.5	4.5	3.5	2.5	1.5	1.0	
700.....	11.5	10.5	9.5	8.5	7.5	6.0	5.0	4.0	3.0	2.0	1.0	
800.....	13.0	12.0	10.5	9.5	8.5	7.0	6.0	4.5	3.5	2.5	1.0	
900.....	14.5	13.5	12.0	10.5	9.5	8.0	6.5	5.5	4.0	2.5	1.5	
1000.....	1.5	5	15.0	13.5	12.0	10.5	9.0	7.5	6.0	4.5	3.0	
2000.....	2.5	5	13.5	11.0	8.0	5.0	2.0	15.0	12.0	9.0	6.0	

## NEUTRALIZING TABLE No. 3

POUNDS OF LIME MIX (HYDRATED LIME) REQUIRED TO REDUCE ACIDITY TO .25 PER CENT

Pounds of Cream	Per Cent Acid in Cream													
	.79%	.77%	.75%	.73%	.71%	.69%	.67%	.65%	.63%	.61%	.59%	.57%	.55%	
lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	
1000....	9.0	8.5	8.0	8.0	7.5	7.0	7.0	6.5	6.5	6.0	5.5	5.5	5.0	
1100....	10.0	9.5	9.0	8.5	8.5	8.0	7.5	7.0	7.0	6.5	6.0	6.0	5.5	
1200....	10.5	10.5	10.0	9.5	9.0	8.5	8.5	8.0	7.5	7.0	6.5	6.5	6.0	
1300....	11.5	11.0	10.5	10.5	10.0	9.5	9.0	8.5	8.0	7.5	7.0	6.5	6.0	
1400....	12.5	12.0	11.5	11.0	10.5	10.0	9.5	9.0	9.0	8.5	8.0	7.5	7.0	
1500....	13.5	13.0	12.5	12.0	11.5	11.0	10.5	10.0	9.5	9.0	8.5	8.0	7.5	
1600....	14.0	13.5	13.0	12.5	12.0	11.5	11.0	10.5	10.0	9.5	9.0	8.5	8.0	
1700....	15.0	14.5	14.0	13.5	13.0	12.5	11.5	11.0	10.5	10.0	9.5	9.0	8.5	
1800....	16.0	15.5	15.0	14.0	13.5	13.0	12.5	12.0	11.5	10.5	10.0	9.5	9.0	
1900....	17.0	16.5	15.5	15.0	14.5	13.5	13.0	12.5	12.0	11.5	10.5	10.0	9.5	
2000....	18.0	17.0	16.5	16.0	15.0	14.5	14.0	13.0	12.5	12.0	11.0	10.5	10.0	
2100....	18.5	18.0	17.0	16.5	16.0	15.0	14.5	14.0	13.0	12.5	11.5	11.0	10.5	
2200....	19.5	19.0	18.0	17.5	16.5	16.0	15.0	14.5	13.5	13.0	12.5	11.5	11.0	
2300....	20.5	19.5	19.0	18.0	17.5	16.5	16.0	15.0	14.5	13.5	13.0	12.0	11.5	
2400....	21.5	20.5	19.5	19.0	18.0	17.5	16.5	16.0	15.0	14.0	13.5	12.5	12.0	
2500....	22.0	21.5	20.5	20.0	19.0	18.0	17.5	16.5	15.5	15.0	14.0	13.0	12.5	
2600....	23.0	22.0	21.5	20.5	19.5	19.0	18.0	17.0	16.0	15.5	14.5	13.5	13.0	
2700....	24.0	23.0	22.0	21.5	20.5	20.0	19.0	18.0	17.0	16.0	15.0	14.0	13.5	
2800....	25.0	24.0	23.0	22.0	21.0	20.5	19.5	18.5	17.5	16.5	15.5	14.5	14.0	
2900....	26.0	25.0	24.0	23.0	22.0	21.0	20.0	19.0	18.0	17.0	16.0	15.0	14.5	
3000....	26.5	25.5	24.5	23.5	22.5	21.5	20.5	19.5	18.5	17.5	17.0	16.0	15.0	

## NEUTRALIZING TABLE No. 3

POUNDS OF LIME MIX (HYDRATED LIME) REQUIRED TO REDUCE ACIDITY TO .25 PER CENT

Pounds of Cream	Per Cent Acid in Cream													
	.53%	.51%	.49%	.47%	.45%	.43%	.41%	.39%	.37%	.35%	.33%	.31%	.29%	.27%
lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.
1000....	4.5	4.5	4.0	3.5	3.5	3.0	2.5	2.5	2.0	1.5	1.5	1.0	.5	.5
1100....	5.0	4.5	4.5	4.0	3.5	3.5	3.0	2.5	2.0	2.0	1.5	1.0	.5	.5
1200....	5.5	5.0	4.5	4.5	4.0	3.5	3.0	3.0	2.5	2.0	1.5	1.0	.5	.5
1300....	6.0	5.5	5.0	4.5	4.5	4.0	3.5	3.0	2.5	2.0	1.5	1.5	1.0	.5
1400....	6.5	6.0	5.5	5.0	4.5	4.0	3.5	3.0	3.0	2.5	2.0	1.5	1.0	.5
1500....	7.0	6.5	6.0	5.5	5.0	4.5	4.0	3.5	3.0	2.5	2.0	1.5	1.0	.5
1600....	7.5	7.0	6.5	6.0	5.5	4.5	4.0	3.5	3.0	2.5	2.0	1.5	1.0	.5
1700....	8.0	7.5	6.5	6.0	5.5	5.0	4.5	4.0	3.5	3.0	2.5	1.5	1.0	.5
1800....	8.5	7.5	7.0	6.5	6.0	5.5	4.5	4.0	3.5	3.0	2.5	2.0	1.0	.5
1900....	8.5	8.0	7.5	7.0	6.5	5.5	5.0	4.5	4.0	3.0	2.5	2.0	1.5	.5
2000....	9.0	8.5	8.0	7.0	6.5	6.0	5.5	4.5	4.0	3.5	2.5	2.0	1.5	.5
2100....	9.5	9.0	8.5	7.5	7.0	6.0	5.5	5.0	4.0	3.5	3.0	2.0	1.5	.5
2200....	10.0	9.5	8.5	8.0	7.0	6.5	6.0	5.0	4.5	3.5	3.0	2.0	1.5	.5
2300....	10.5	10.0	9.0	8.5	7.5	7.0	6.0	5.5	4.5	4.0	3.0	2.5	1.5	1.0
2400....	11.0	10.5	9.5	8.5	8.0	7.0	6.5	5.5	4.5	4.0	3.0	2.5	1.5	1.0
2500....	11.5	10.5	10.0	9.0	8.0	7.5	6.5	6.0	5.0	4.0	3.5	2.5	1.5	1.0
2600....	12.0	11.0	10.5	9.5	8.5	7.5	7.0	6.0	5.0	4.5	3.5	2.5	1.5	1.0
2700....	12.5	11.5	10.5	10.0	9.0	8.0	7.0	6.0	5.5	4.5	3.5	2.5	2.0	1.0
2800....	13.0	12.0	11.0	10.0	9.0	8.5	7.5	6.5	5.5	4.5	3.5	3.0	2.0	1.0
2900....	13.5	12.5	11.5	10.5	9.5	8.5	7.5	6.5	5.5	5.0	4.0	3.0	2.0	1.0
3000....	14.0	13.0	12.0	11.0	10.0	9.0	8.0	7.0	6.0	5.0	4.0	3.0	2.0	1.0